IMPROVED TRUCK BED TOOLBOX LID METHOD OF MANUFACTURE

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BACKGROUND OF THE INVENTION

1. Technical Field:

The present invention relates generally to the field of truck bed toolboxes. More particularly, the present invention relates to an improved truck bed toolbox and toolbox lid combination that is structurally improved to better withstand the bending and twisting forces experienced by such toolboxes as disposed and utilized in the beds of pick-up trucks, and the method of manufacturing such truck bed toolbox lid.

2. Description of the Related Art:

A truck bed toolbox is a well known pick-up truck accessory which is essentially a storage cabinet designed for outdoor exposure and having a distinctive outer contour and dimensions suitable for being fixedly mounted in the open bed of a pick-up truck, generally just to the rear of the passenger compartment. Such a toolbox typically comprises a generally rectangular, open topped lower receptacle or tub, to which is pivotally attached one or more lid members. A single lid is typically attached by hinges affixed along the longitudinal rear edge of the lid and the back wall of the tub if a single lid, or a pair of lids are affixed by hinges affixed

transversely adjacent the lateral middle of the tub. Closure means, latches, locks or the like are provided to secure the lid or lids in the closed positioned. The box may be provided with lift cylinders and detent means to maintain the lid in the open position, or other features. Such devices are well known, and typified in being constructed of metallic sheet members suitable for accommodating large, heavy metallic tools.

The truck bed box/lid combination are typically constructed of relatively rigid, aluminum sheet material having requisite strength and corrosion resistance characteristics. The individual aluminum panels of a truck bed toolbox typically have a thicknesses of from 0.080 to 0.063 mil, and are welded or mechanically fastened to define the sheet metal box structure characteristic of truck bed tool boxes. Since they must span the width of a truck bed compartment, these specialized toolboxes are relatively large typically ranging from 54 to 75 inches in width, from 19 to 28 inches in depth and from 13 to 14 inches in height. The disproportionate width (i.e. 54 to 75 inches) is a distinct characteristic of truck bed toolboxes for helping to maintain the toolbox anchored in relative abutment with the interior sidewalls of the truck bed such that the toolbox remains within a designated cross section area of the truck bed while experiencing shifting forces resulting from the truck's motion while being driven. The disproportionate width dimension is also useful for truck bed applications by rendering the lid accessible to a user standing on the side of the host truck's bed and reaching over the bed sidewall to open the toolbox.

Because the lid is the main movable component of the toolbox, it is subjected to repetitive forces from many directions and is therefore the component most susceptible to damage or failure. Due to the relatively large width dimension necessitated by the reasons set forth above and its flat, metallic sheet construction, a truck bed tool box lid is particularly susceptible to twisting and bending forces resulting from users opening the toolbox by pushing

up on or near an outer end of the lid accessible while standing outside the truck bed. If the lid becomes twisted or otherwise misaligned, proper closure to seal the box from the elements becomes difficult or impossible, and the toolbox must then be repaired or replaced. It is therefore necessary to impart significant rigidity to prevent the lid from bending, crimping, torqueing, twisting, failing or becoming misaligned relative to the tub. It is standard practice to fasten structural bracing members on the underside of the lid to increase planar rigidity, the bracing members extending either longitudinally or laterally, but the efficacy of these brace members is limited by the desire to minimize cost and weight factors, such that manufacturers attempt to use the smallest or the fewest brace members which will still provide a minimally acceptable increase in rigidity and structural integrity.

Another method for increasing the rigidity and structural integrity of the lid is to provide an interior liner sheet to form a cavity into which pre-cured, cut-to-size, rigid foam sheets are inserted. However, in order to achieve the desired load transfer across the component materials necessary to resist shearing and buckling forces requires that adhesive agents be applied to the contact surfaces which greatly increases the time and cost of production of each truck bed toolbox lid. Furthermore, employing pre-formed foam sheets results in cutting the foam sheets to size resulting in significant waste of materials and in environmental hazards in disposing of the same.

It can therefore be appreciated that a need exists for an improved truck bed toolbox lid and method of producing the same, wherein the truck bed toolbox lid is lighter and less susceptible to misalignment.

SUMMARY OF THE INVENTION

An improved truck bed toolbox, an improved truck bed toolbox lid, and a method of producing the same are disclosed herein. The truck bed toolbox lid includes a metallic liner bounded cavity filled with high density injected foam to provide superior strength and rigidity, to maintain the lid alignment and to virtually eliminate the need to adjust lid strikers. In accordance with the present invention, the lid comprises an outer layer of aluminum or similar sheet material, the outer layer comprising a generally rectangular top sheet member, a longitudinal front edge member, two lateral edge members and a longitudinal rear edge member, where the edge members depend from the metallic top sheet member and overlap the upper edges of the truck bed toolbox rectangular tub or base. A liner sheet member of aluminum or other suitable metal is positioned to the inside of and substantially parallel to the metallic top sheet member. The liner sheet member is spaced a short distance from the top sheet member to create an internal cavity in which the liner is disposed in edge contact abutment with beveled inside edges of the front and rear longitudinal edge members and the lateral edge members by stitch welding. One or more injection ports are provided through the liner sheet member through which a self-expanding and self-curing, relatively high-density, foam is injected to completely fill the interior cavity. The stitch welded edge contacts leave non-sealed, gas permeable junctions along the wedged cavity periphery at the funneled apex of the edge contacted boundary which facilitate expansion of the foam toward the outermost edges of the cavity to maximize the foam coverage at points furthest from the foam injection site. The cured, expanded foam adheres to the inside surfaces of the metallic top sheet member and the inside surface of the metallic liner sheet member, creating a rigid composite structure whereby shearing and twisting forces are more

evenly distributed through the composite structure, such that the lid is able to withstand much greater detrimental forces without permanent flexing, bending, crimping or failure.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view showing a truck bed toolbox according to the present invention with the lid in the closed position attached to the tub.

Figure 2 is a cross-sectional view of a truck bed toolbox lid in accordance with one embodiment of the present invention.

Figure 3 is a bottom view of a truck bed toolbox lid in accordance with one embodiment of the present invention.

Figure 4 is a bottom view of a truck bed toolbox lid in accordance with an alternate embodiment of the present invention.

Figure 5 depicts an apparatus for preparing and assembling a truck bed toolbox lid in accordance with a preferred embodiment of the present invention.

Figure 6 is a flow diagram illustrating steps performed during production of a truck bed toolbox lid in accordance with a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

With reference to the drawings, the invention will now be described in detail with regard for the best mode and the preferred embodiment.

As explained in further detail with reference to the figures, the present invention is directed to an improved truck bed toolbox lid having greater rigidity and resistance to bending and twisting than standard constructions, where the improved lid is relatively easy to manufacture at lower costs. The improved internal support is provided by an improved injected foam process and results in a highly resilient truck bed toolbox lid having optimum rigidity characteristics such that the thickness of the lid shell material may be reduced (from .080 mil to .063 mil, for example) while increasing the flexural integrity of the lid. Furthermore, the improved truck bed toolbox lid assembly method described herein provides a more efficient assembly line process resulting in less man-hours per toolbox assembly and a corresponding increase in the rate of production.

With reference now to the figures wherein like reference numerals refer to like and corresponding parts throughout, and in particular with reference to **Figure 1**, there is depicted a perspective view showing a truck bed toolbox according to the present invention with the lid in the closed position attached to the tub. In particular, **Figures 1** illustrates the apparatus of the present invention as generally comprising a structurally superior truck bed toolbox lid **20** for a truck bed toolbox **10** of the type configured to be positioned in the bed of the open cargo area of a pick-up truck, usually abutting the rear of the cab and extending laterally across the bed. The box **10** typically includes a generally rectangular tub or base member **15** having upstanding side walls **11** with upper edges **12**. The box **10** is provided with latching or locking means **13** to secure the lid **20** in the closed position, and the lid **20** is pivotally joined to the tub **15** by hinge

means **14**. The major structural components are preferably composed of sheet metal, such as aluminum. In the depicted embodiment, the box **10** is shown as comprising a single lid **20**, but it is to be understood that the structure as described herein is applicable to truck bed toolboxes having pairs of lid members, in which case the lid members are pivotally joined to the tub along a lateral edge, preferably an interior lateral edge with the hinges mounted transversely.

Preferably, the tub **15** is produced by cutting and folding an aluminum sheet to create the front, bottom and back walls with the side walls welded to create the full base structure. Likewise, the outer panels of the lid **20** are preferably formed by cutting and folding a single aluminum sheet to form the top sheet member **21**, front edge member **22**, lateral edge members **23** and rear edge member **24**.

Referring to **Figure 2** in conjunction with **Figure 1**, the truck bed toolbox lid **20** comprises a generally planar top or outer sheet member **21** from which depend a longitudinal front edge member **22**, a pair of opposing lateral edge members **23** and a rear edge member **24**, where one or more hinge means **14** are connected in some manner to the rear edge member **24** such that the lid **20** can be pivoted preferably at least 90 degrees from the tub **15** in the open position. Lift cylinders or detent means, not shown but known in the art, may be provided to retain the lid **20** in the open position. The edge members **22, 23** and **24** form a complete perimeter around the metallic top sheet member **21**, which is sized to allow the edge members **22, 23** and **24** to overlap the upper edges **12** of the tub walls **11** to preclude entry of rain, dirt and other detrimental environmental effects. As depicted in **Figures 1** and **2**, edge members **22, 23** and **24** are preferably partially beveled between the top horizontal surface of top sheet member **21** and the vertically depending portion of the edge members. Furthermore, all or some of edge members **22, 23** and **24** may be provided with a hem **25**, which is formed by bending the outer

portion of the edge member **22**, **23** or **24** back upon itself such that a rounded configuration is presented in areas where the user may contact the edge members **22**, **23** and **24**.

The truck bed toolbox lid **20** further comprises a metallic liner sheet member **30**, preferably formed of a sheet metal such as aluminum, which is mounted on the inside of the metallic top sheet member **21**. The metallic liner sheet member **30** is preferably planar and substantially coextensive and parallel with the metallic top sheet member **21** in the horizontal direction, but is separated from the metallic top sheet member **21** a short distance to define an interior cavity **42**. As depicted in **Figure 2**, the metallic liner sheet member **30** is preferably disposed at its edges **31** in substantially continuous abutment along the inside beveled surfaces of edge members **22**, **23** and **24**. The edges **31** of the liner sheet member **30** are fixedly connected to the edge members **22**, **23** and **24** by multiple, individual stitch or spot welds **99** preferably having a width from 0.5" to 1.5" and being spaced apart by 2" to 6" along the perimeter of metallic liner sheet member **30**. In accordance with a preferred embodiment, the liner edges **31** are hemmed or otherwise bent or manipulated to provide a suitably enlargened weld surface on liner edges **31** and furthermore to provide a suitably dimensioned "well" in which a heat-activated adhesive can be deposited after stitch welding. Preferably the stitch welds **99** extend for short distances of one inch or less, as this technique minimizes damage to the aluminum sheets from the heat of welding. Moreover, utilization of discrete weld joints in this manner provides a particularly well-suited forum for implementing a foam injection technique explained in further detail with reference to **Figure 3**. In alternative embodiments, suitable means such as mechanical fasteners may be utilized for applying discrete suitably spaced attachment joints to affix the metallic liner sheet member **30** to the metallic top sheet member **21**.

With reference to **Figure 3**, there is illustrated a bottom view of a truck bed toolbox lid in accordance with one embodiment of the present invention. Specifically, **Figure 3** depicts the underside of the lid **20** wherein the rectangular periphery of liner sheet member **30** is situated in edge contact within a continuous, beveled edge perimeter **33** formed along the depending front, rear and lateral edge members on the underside cavity of the top sheet member **21**. The metallic liner sheet member **30** is provided with one or more injection ports or apertures **41**, which allow a self-expanding, self-curing foam material **40** to be injected into the interior cavity **42**, where it self-bonds and adheres without need for application of a separate adhesive material to the inside of the metallic top sheet member **21**, the metallic liner sheet member **30** and the edge members **22**, **23** and **24**, depending on the configuration of the metallic liner sheet member **30**, to create a rigid, integral, composite material lid **20** which has improved damage- and failure-resistance properties. A suitable foam **40** for injection into the interior cavity **42** is a combination of ISOFOAM R-1322B, a polyurethane polyol blend containing a surfactant, catalyst, flame retardant and hydrochlorofluorocarbon, and ISOFOAM I-0732A, a polyurethane isocyanate, sold by IPI International, Inc., which upon reaction forms a foam of relatively high density which adheres to the aluminum members and cures into a rigid body.

Between the multiple stitch welds **99** are corresponding weld gaps **36** through which air and gases incident to the foam expansion process can escape through the gas permeable non-welded portions of the liner-to-top-sheet-member edge junction at the periphery of the inner liner member **30** that facilitates comprehensive migration of the foam toward the edges of the inner liner member **30** thereby defining a funneled, gas permeable apex boundary. This gas exhaust capability is usefully employed in the parallel plane boundary of the internal cavity **42** in which upon injection of the liquid foam, pockets of air and other gases may become sealed off by the

expanding foam from otherwise available vent holes through the surface of liner sheet member **30**. The parallel plane internal contour of the internal cavity **42** ensures that gasses that are not exhausted through the injection or ventilation ports in the surface of the inner sheet member **30** are directed toward the outermost apex boundary of the internal cavity **42** where the wedged contour of the liner-sheet-to-beveled-edge boundary creates a nozzle effect that facilitates expulsion of the gasses through the weld gaps **36**. Furthermore, although gas permeable, the non-welded contact junctions at weld gaps **36** between the edges of the inner liner **30** and the beveled portions of the top sheet edges **22, 23** and **24** provides a significant degree of resistance to foam expansion to prevent excessive foam expansion through the weld gaps **36** sufficient to account for any incidental process variations of a timed or metered foam injection process.

An alternative truck bed toolbox lid **25** is depicted in **Figure 4**, wherein a hot glue seal **34**, referred to alternatively as a hot melt seal, is disposed along the gaps of the outer perimeter of the metallic liner sheet member **30**, such that upon cooling the hot glue sealing member forms a continuous seal between the inside surface of the top sheet member **21** and the outer edge perimeter of the liner sheet member **30**. As explained in further detail with reference to **Figure 6**, hot glue seal **34** is applied during assembly of the truck bed toolbox lid prior to injection of the foam into the internal cavity **42**. Hot glue seal **34** retains the foam **40** within a defined area and prevents the foam **40** from expanding through the weld gaps **36** between the stitch welds **99**.

It has been found that the presence of the cured foam **40** in the interior cavity **42** bonding the upper sheet member **21** to the metallic liner sheet member **30** is a much stronger construction than that of the previously known constructions, enabling thinner metal sheets to be utilized in the construction of the lids **20** and obviating the need for interior bracing members, which lowers material costs yet still provides improved properties over standard constructions. For example, a

suitable lid **20** is formed with a one half to three quarter inches in depth cavity **42** between a liner sheet member **30** of only 0.050 mil metallic sheet thickness and a top sheet member **21** of only 0.063 mil metallic sheet thickness.

Referring to **Figure 6**, there is depicted a flow diagram illustrating steps performed during production of a truck bed toolbox lid in accordance with a preferred embodiment of the present invention. The process begins as shown at step **52** and proceeds to steps **54** and **56** with the inner sheet liner **30** being placed on and stitch welded to the beveled edge perimeter **33**. Next, as depicted at step **58**, hot glue seal **34** is applied along the stitch welded perimeter. In accordance with one embodiment, the seal is applied using a glue gun (not depicted) consisting of a handle, an electrically heated, thermostatically controlled melting chamber and an application nozzle. The hemmed liner edges **31** form a provide a suitably dimensioned trough or "well" in which the heat-activated adhesive can be deposited after stitch welding. It should be noted that the hot glue application step **58** is optional and that the truck bed toolbox lid **20** may be produced as previously discussed without utilizing the hot glue seal **34**.

Following application of hot glue seal **34**, the truck bed toolbox lid **20** is placed in a clam-style jig in preparation for the foam injection process. **Figure 5** illustrates an example clam-style jig **45** into which the truck bed toolbox lid **20** is placed prior to and during the foam injection process. Cavity support members **44** are provided within the interior cavity **42** to structurally support the liner sheet member **30** prior to the foam injection process. The liner sheet member **30** is braced by suitable blocks **46** such that it does not flex outward after the foam **40** begins to expand. Proceeding to step **61**, the foam is injected through the injection ports **41** in metered amount under controlled conditions such that the interior cavity **42** is filled to capacity upon expansion and curing. As illustrated at step **63**, prior to and/or during the foam injection

step, a heater element **48** is situated beneath the braced lid and utilized to heat the metallic sheet members **30** and **21** to control the rate at which the injected foam cures and thereby facilitate maximum expansion and a relatively uniform time at which the expanded foam finally cures as a rigid member. The injection is terminated (step **69**) either automatically, if using a metered or timed foam injection system (steps **64** and **65**), or in accordance with an operators inspection and judgment (steps **64** and **67**).

Following the foam injection process, the injection ports **41** are covered by one or more adhesive members so that the foam **40** does not expand through the injection ports **41**. The lid **20** is left in the jig for sufficient time such that the vast majority of the expansion has occurred, and the lid **20** is then removed from the jig and allowed to fully cure. With this structure, the lid **20** can be further processed, such as by powder coating, painting or the like to produce aesthetic improvements, some of which processes require high temperature environments detrimental to the foam **40**, with the foam **40** later injected into the interior cavity **42** to increase structural rigidity and stiffness.

Tests on lids **20** constructed as described versus standard lids or lids with inserted pre-cured, cut-to-size, foam panels show remarkable improvements relative to desired stiffness characteristics. In a first test apparatus, lids were clamped or secured along one end to a horizontal platform such that approximately half the lid extended beyond the edge of the platform. Pressure was applied using a hydraulic jack to the free end of the lid adjacent the free lateral edge member **23** at the midpoint or center. Pressure was applied until the lid failed, with failure defined to be crimped edges with the lid taking on a permanently deformed set. The lid **20** of the invention was able to withstand up to 480 psi of vertical pressure prior to failure, while the standard lid construction failed at 250 psi and the insert construction failed at 360 psi. In

addition, the standard lid construction failed at only 1.25 inches of deflection, the insert construction failed at only 4 inches of deflection, while the lid **20** of the invention did not fail until deflected 6.25 inches. In other words, the lid **20** of the invention could be flexed slightly less than 6.25 inches at 480 psi and would resume its pre-test shape without any permanent deformation.

In a second test, the pressure was applied to one corner of the free end of the lids to introduce torque. For the torque load tests, the invention withstood up to 490 psi without failure, while the standard lid failed at 280 psi and the insert lid failed at 310 psi. The standard lid failed at only 1.25 inches of deflection and the insert construction failed at only 5 inches of deflection. The lid **20** of the invention did not fail even at deflection of almost 7.5 inches under the failure definition set forth above.

It is contemplated that equivalents and substitutions to certain elements set forth above may be obvious to those skilled in the art, and thus the true scope and definition of the invention is to be as set forth in the following claims.